NGST Systems Engineering Report

Thermal Subsystem 9

Title: **Performance of Incorporating Various ‘V-Grooves’ Into Six Layer Shield Baseline**	
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References:	

Description

The purpose of this SER is to clarify understanding regarding the thermal performance of an angled NGST sunshield. This type of sunshield has also been described as a ‘v-groove’ sunshield based on configurations studied for the Fall 1997 Quarterly. The current NGST ‘yardstick’ sunshield consists of six parallel layers. An angled or ‘v-groove’ sunshield has each or some of the layers angled with respect to each other to provide more of an edge gap to enhance thermal radiation from between the layers to space. Thermal analyses at the presented at the Fall ’97 Quarterly studied the effects of an angled four layer shield design and compared it to the then baselined four parallel layer configuration. The amount of angle between the two pairs of parallel layers, shown in Figure 1, was varied and the resulting thermal performance was compared to a parallel design with a variable number of layers. The results of this comparison are shown in Figure 2. Obviously, thermal performance improves with the number of sunshield layers and with the angle or effective spacing between them. The results also show that a six parallel layer shield performs as well as a four layer shield with a 10° ‘v-groove.’

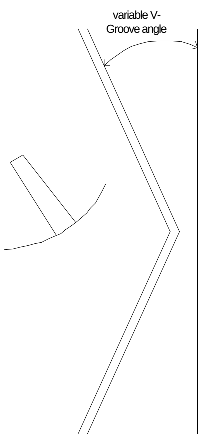

Figure 1: V Groove Sunshield
Studied For Fall 97 Quarterly

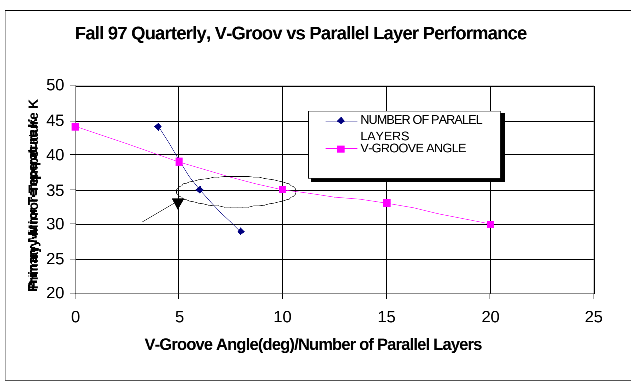

Figure 2

It is important to note that there are a variety of ways in which to incorporate an angled shade design, and each interpretation will perform differently. The Fall 97 study only examined one specific type of angled shield and its performance suffered because it still used pairs of closely spaced parallel layers. An intuitive understanding of radiative heat transfer concluded that some type of angle will improve performance. As the edge gap is decreased, more layers must be added to attenuate the incident solar energy. A parallel layered shield relies more on attenuation where as an angled design relies more on radiation to space from between the layers. Whether or not, and to what extent, angled layers are incorporated depends more on mechanical implementation issues. Mechanical design studies need to address both angled and parallel shield layer configurations.

The latest thermal analyses of an angled sunshield configuration was performed by incorporating angles into the currently baselined six parallel layer design. This study differs from the Fall 97 study in that there are no parallel layers and the axis about which the layers were angled differs by 90°. Each layer was gradually angled until the last or OTA facing layer was angled to the maximum extent. This study was performed for comparative purposes only to demonstrate performance gains if the baselined six parallel layer design is opened up or angled. Also examined was an angled two and four layer shield design.

Results Summary

Figure 3 illustrates the three configurations analyzed. Table 1 compares the average OTA temperatures from the study results and compares them to the six parallel layer baseline results. The primary finding of this study is that a four layer angled design utilizing gradually increasing angles performs better than the current six parallel layer design. A simple two layer system performs poorly. Another interesting result is that the petal to petal mirror gradients are

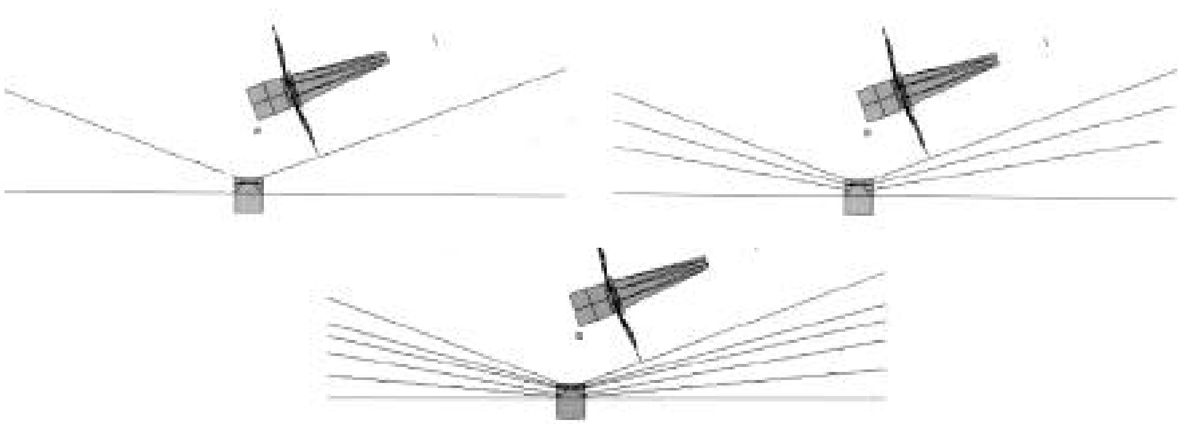

Figure 3: 2, 4, and 6 Layer Configurations Studied

decreased due to the closer proximity of the shade to the mirror. Significant improvement is realized when a six layer configuration is angled to the maximum extent. The average primary mirror temperature drops to 29 K

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Table 1 Results Summary

	Baseline 6 parallel layers	2 angled layers	4 angled layers	6 angled layers
OTA Facing Layer	85 – 151 K	119 – 214 K	38 – 118 K	23 – 86 K
Max Primary Mirror	53 K	75 K	43 K	36 K
Min Primary Mirror	31 K	46 K	26 K	22 K
Avg. Primary Mirror	***42 K***	***60 K***	***35 K***	***29 K***

Modeling Discussion

The baselined six parallel layer thermal geometry model was modified such that each layer was gradually angled such that the last OTA layer was as close as possible to the OTA without touching. For all cases the sun facing layer remained perpendicular to the sun line. Radiation interchange factors were then computed using TSS for the new configurations. Optical properties and environmental constants were the same as for the end of life baseline. Fully diffuse properties were assumed on the low emittance inner facing shade surfaces.